[0068] Although **FIGS. 4-8** depict essentially vertical flow through the channels, these distillation units may be aligned horizontally to provide for horizontal flow through the channels, or they may be aligned at an inclined angle from the horizontal.

[0069] An alternate embodiment of the microchannel condenser **120** illustrated in **FIGS. 1 and 2** and the microchannel condenser **120**B illustrated in **FIG. 8** is disclosed in **FIGS. 9-11**. Referring to **FIGS. 9-11**, microchannel condenser **500** comprises process microchannel **510**, liquid channels **520** and **530**, heat exchange channels **540** and **550**, and outlet **560**. Liquid channel **520** includes wicking region **525** and outlet **527**, and liquid channel **530** includes wicking region **535** and outlet **537**. Process microchannel **510** is positioned between liquid channels **520** and **530**. Heat exchange channels **540** are adjacent to liquid channel **520**. Heat exchange channels **550** are adjacent to liquid channel **530**. Process microchannel **510** includes inlet **511** for permitting vapor to flow into the process microchannel **510**, and outlets **512** and **514** for permitting condensed vapor to flow from process microchannel **510** into wicking regions **525** and **535**, respectively. In operation, vapor **518** flows through inlet **517** into process microchannel **510** in the direction indicated by arrow **516** and condenses to form condensed vapor **519** which may be referred to as distillation product D. Heat exchange fluid flows through heat exchange channels **540** and **550** in a direction that is crosscurrent relative to the flow of vapor in the process microchannel **510**. Part or all of the condensed vapor may flow through outlet **560**, as indicated by arrow **562**. The remaining condensed vapor may flow through outlets **512** and **514** into wicking regions **525** and **535**, respectively. The distillate product flowing in the wicking regions **525** and **535** flows in the direction indicated by arrows **526** and **536** through outlets **527** and **537**, respectively.

[0070] An alternate embodiment of the microchannel reboiler **130** illustrated in **FIGS. 1 and 2** and the microchannel reboiler **130**B illustrated in **FIG. 8** is disclosed in **FIGS. 12-14**. Referring to **FIGS. 12-14**, microchannel reboiler **600** comprises process microchannel **610**, liquid channel **620**, and heat exchange channels **630** and **640**. Liquid channel **620** includes wicking region **625**. Process microchannel **610** is positioned between liquid channel **620** and heat exchange channels **630**. Heat exchange channels **640** are adjacent to liquid channel **620**. Process microchannel **610** includes outlets **612** and **614**, and inlet **616**. In operation, liquid **619** flows through wicking region **625** to inlet **616**, and through inlet **616** into process microchannel **610**, as indicated by arrow **626**. Heat exchange fluid flows through heat exchange channels **630** and **640** in a direction that is crosscurrent relative to the flow of liquid through the wicking region **625**. Part or all of the liquid **619**, which is in the form of bottoms product B, may flow through outlet **612**, as indicated by arrow **613**. The remainder of the bottoms product B may be vaporized. The vapor **618** flows through process microchannel **610** in the direction indicated by arrow **615** and out of process microchannel **610** through outlet **614**.

[0071] An alternate embodiment of the microchannel reboiler **130** illustrated in **FIGS. 1 and 2** and the microchannel reboiler **130**B illustrated in **FIG. 8** is disclosed in **FIGS. 15-17**. Referring to **FIGS. 15-17**, microchannel reboiler **700** comprises process microchannel **710**, liquid channel **720**, and heat exchange channels **730** and **740**. Liquid channel **720** includes wicking region **725**. Process microchannel **710** is positioned between liquid channel **720** and heat exchange channels **730**. Heat exchange channels **740** are adjacent to liquid channel **720**. Process microchannel **710** includes outlets **712** and **714**, and inlet **716**. In operation, liquid **719** flows through wicking region **725** to inlet **716**, and through inlet **716** into process microchannel **710**, as indicated by arrow **726**. Heat exchange fluid flows through heat exchange channels **730** and **740** in a direction that is crosscurrent relative to the flow of liquid through the wicking region **725**. Part or all of the liquid **719**, which is in the form of bottoms product B, may flow through outlet **712**, as indicated by arrow **713**. The remainder of the bottoms product B may be vaporized. The vapor **718** flows through process microchannel **710** in the direction indicated by arrow **715** and out of process microchannel **710** through outlet **714**.

[0072] The microchannel condenser (**120**, **120**B, **500**) and microchannel reboiler (**130**, **130**B, **600**, **700**) as components of the inventive microchannel distillation unit (**300**, **300**A, **300**B, **400**) can be integrated into the manifolds (header and footer) of the process microchannels (**310**, **420**, **425**, **420***a*, **425***a*) and liquid channels (**330**, **415**). An example of manifolding with an integrated microchannel reboiler is shown in **FIGS. 12-14**. The liquid from the last section of the liquid channel (stream **336** in **FIG. 8**) flows into the footer/reboiler section at the unit end and is heated by the heat exchange channels **630** and **640**. Vapor is formed and flows upwards, as indicated by arrow **615**, back into the process channels via buoyancy. Part of the liquid is drained through the common outlet **612** at the bottom as the bottoms product so that a splitting of boil-up ratio can be controlled by the flow conditions and configuration of the microchannel reboiler. Another example is illustrated in **FIGS. 15-17** where the common outlet of the process channels' footer is located at the side. To prevent carryover of the vapor by the liquid to be drained as product, an extruded edge may be made at the end of each horizontal separation wall. As the heat transfer area is different from channel to channel in a single layer of the unit, the duty of the reboiler microchannel may have to be different. For example, the duty in heat exchange channel **740**A may have to be higher than in channel **740**B, as horizontal channel **740**A is shorter than **740**B. Control of the duty in an individual microchannel reboiler heat exchange channel can be made by changing flow rate, inlet temperature and/or pressure.

[0073] The manifold (header) may be located at the end of the unit (**FIGS. 9-11**) where vapor is cooled and partly condensed by the integrated microchannel condenser. The condensation occurs on the wicking structure surface as heat is removed from the wick by the integrated condenser. The condensate may be enriched in the less volatile component and is sucked in by the wicking structure and transported along the liquid channel. The uncondensed vapor leaves the outlet of the manifold so that a reflux is realized. The reflux ratio can be controlled by controlling the duty of the microchannel condenser.

[0074] The microchannel distillation unit **300**C illustrated in **FIG. 18** is a slightly modified version of the microchannel distillation unit **300**A illustrated in **FIG. 5**. The microchannel distillation until **300**C contains a plurality of adjacent distillation units **302** arranged in parallel spaced rows **303**.